Right-sizing the Logistics Deployment Footprint

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Purpose

NORTHROP GRUMMAN

- Present A Simulation-Based Methodology For Sizing The Logistics Footprint In Terms Of Personnel And Material Required To Support A 30-Day Aircraft Deployment
- Propose A Methodology To Quantify The Cost Savings/Avoidance Associated With The “Optimal” Footprint

Agenda

NORTHROP GRUMMAN

- Tool Overview
- Scenario And Trade Space
- Input Data
- Initial Results
- Deployment Footprint
- Cost Implications
- Conclusions

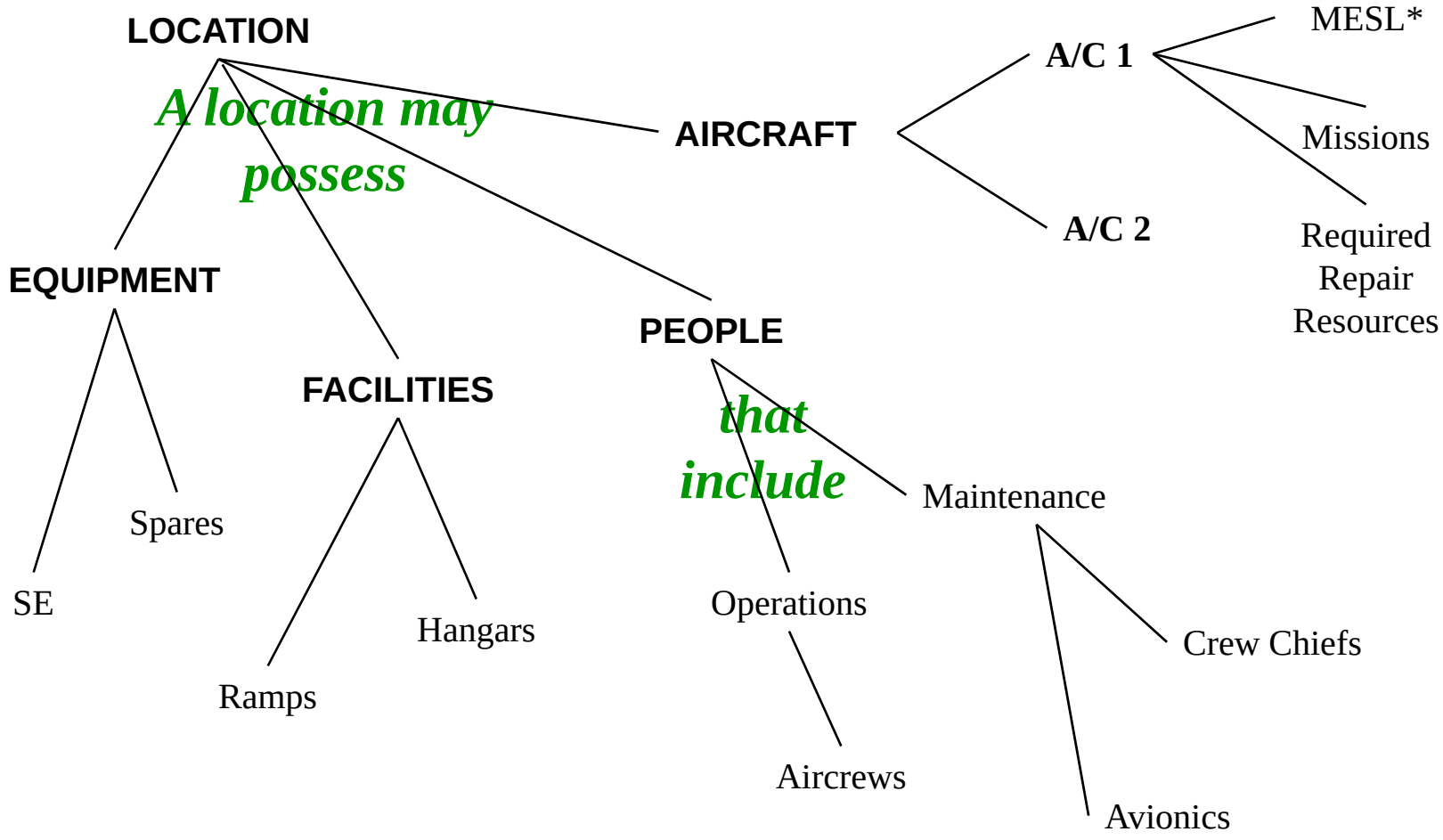
Tool Over View: Model for Aircraft Availability Forecasting (MAAF)

Model For Aircraft Availability Forecasting (MAAF)

NORTHROP GRUMMAN

- An Object-oriented, Simulation Modeling Application Intended To Help Designers, Analysts And Planners Conduct Rapid Analyses Of A Variety Of Logistics Problems, Including:
  - Predicting Weapon System Availability Under Various Operational Scenarios
  - Allocating Logistics Resources Based On Mission Requirements
  - Impact Of Maintenance And Operational Policies On Aircraft Availability And Resources
  - Assessment Of R&M Improvements On Weapon System Availability And Logistics Resource Requirements
  - Sizing Units, Readiness Spares Packages (RSPs), Etc.
  - Analyzing The Impact Of Force Structure Changes

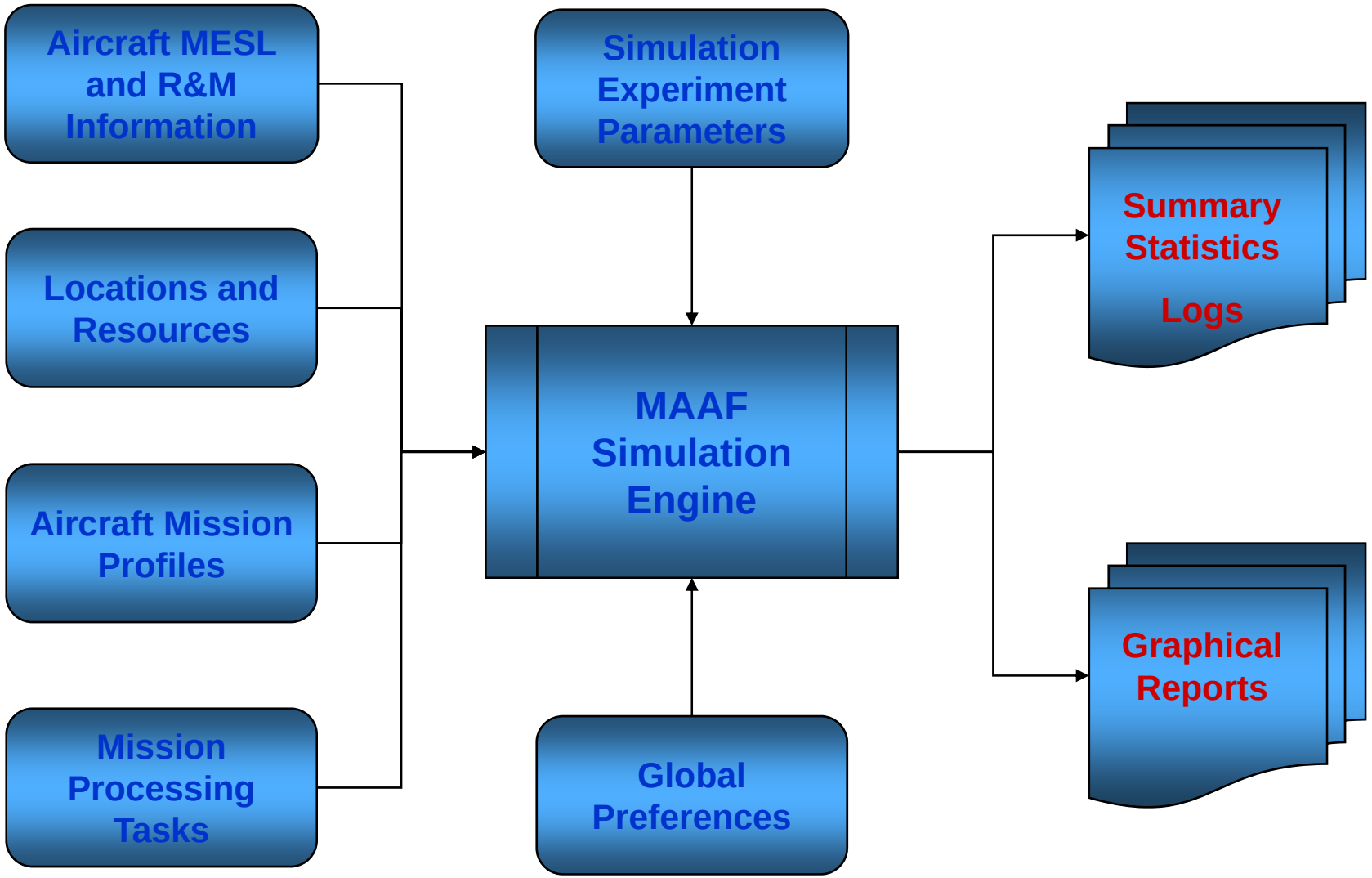
MAAF Object Oriented Framework



MAAF Supports the Rapid Configuration of Scenarios to Simultaneously Assess Mission and Support Requirements

*** Minimum Essential Subsystem List**

MAAF Simulation Framework

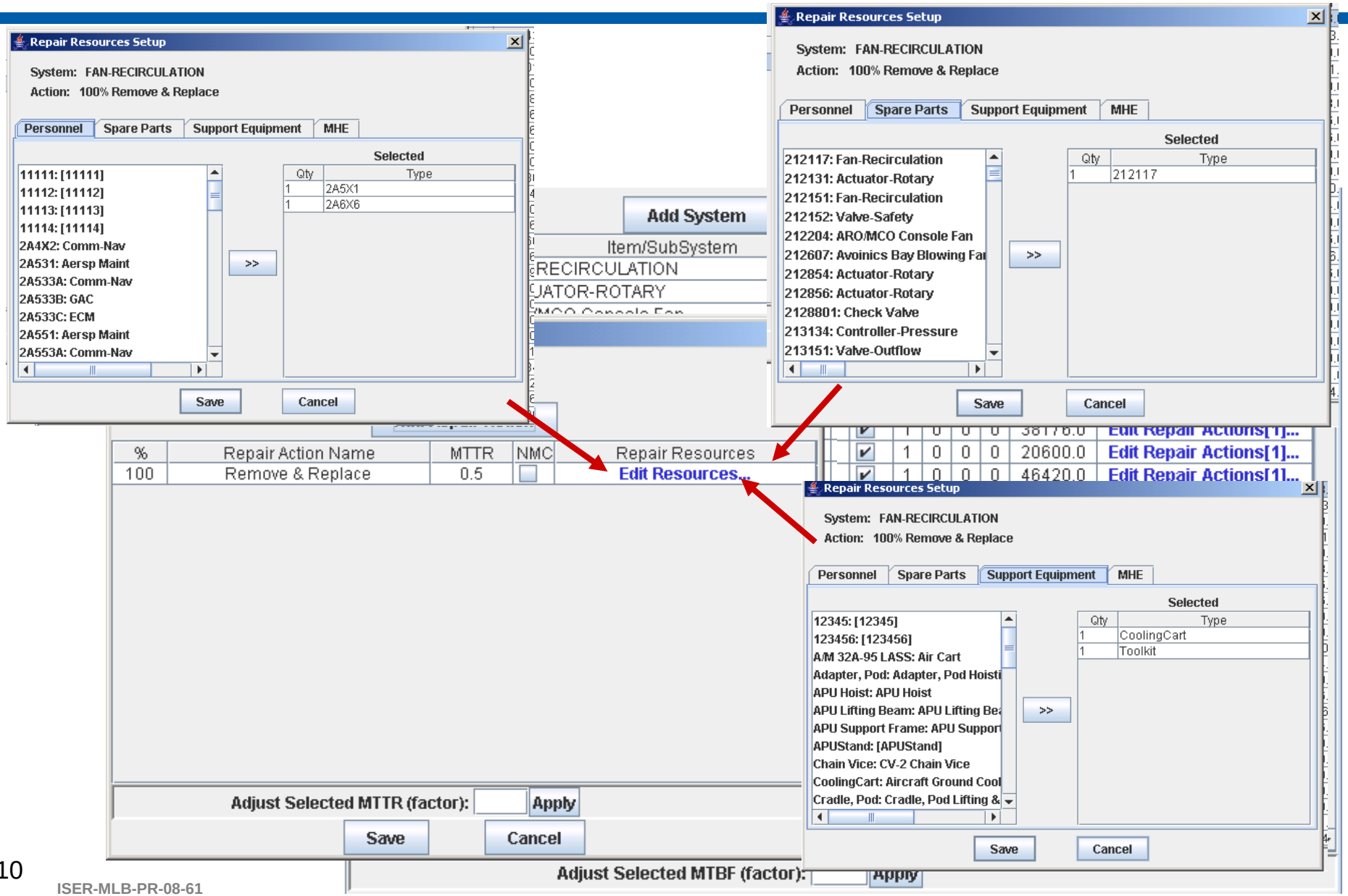


MAAF Inputs

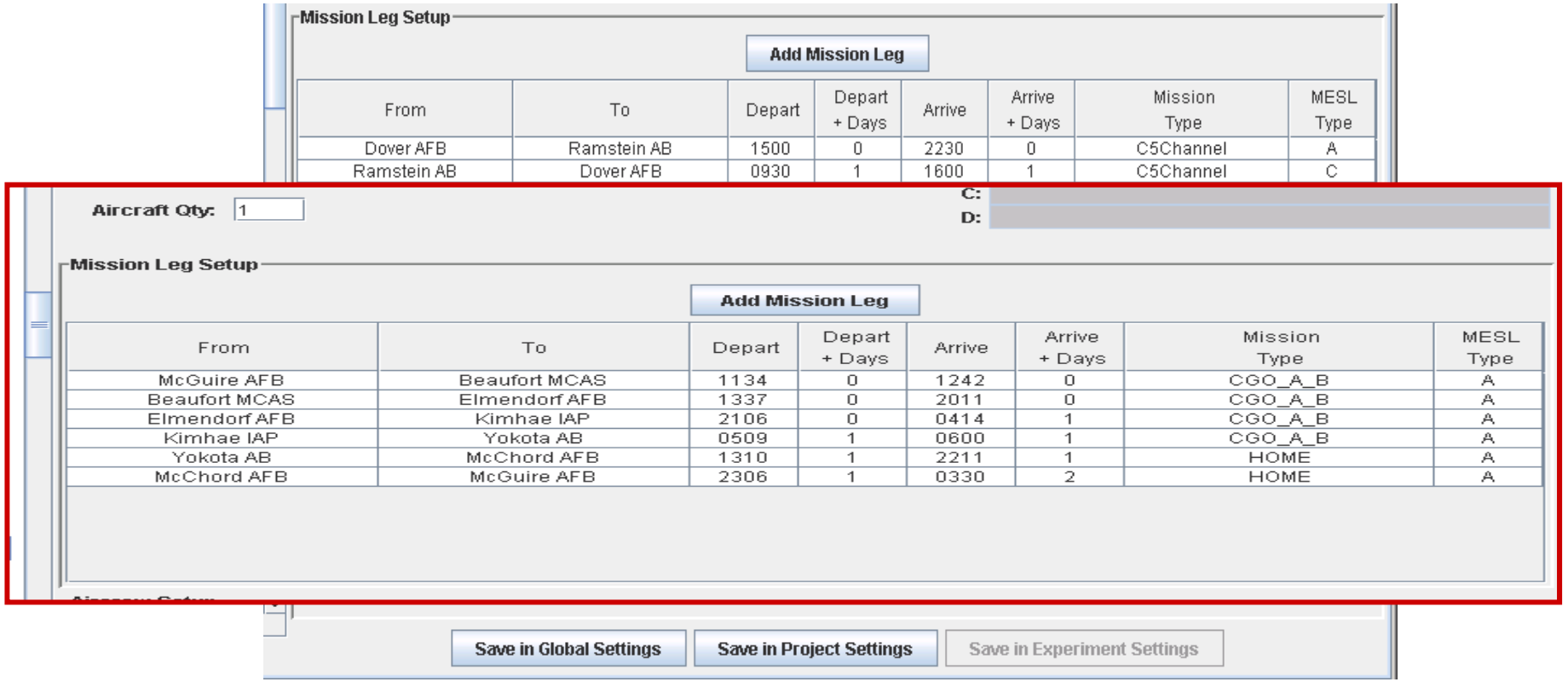
- Aircraft System R&M Data
  - Flight/Mission Critical Elements, Reliability, Maintainability, Repair Resources
- Mission Data
  - Mission Type, Aircraft Type and Qty., Departure/Arrival Locations and Times, Minimum Essential Subsystem List (MESL) column reference
- Location Resources
    - Maintenance Personnel *
    - Spares *
    - Support Equipment (SE) *
    - Material Handling Equipment (MHE)*
    - Aircrews (optional) *
- Mission-based Tasks (e.g. Preflight) and Activities (e.g. phased or isochronal inspections)

*** Can be auto-generated in unconstrained simulation experiment**

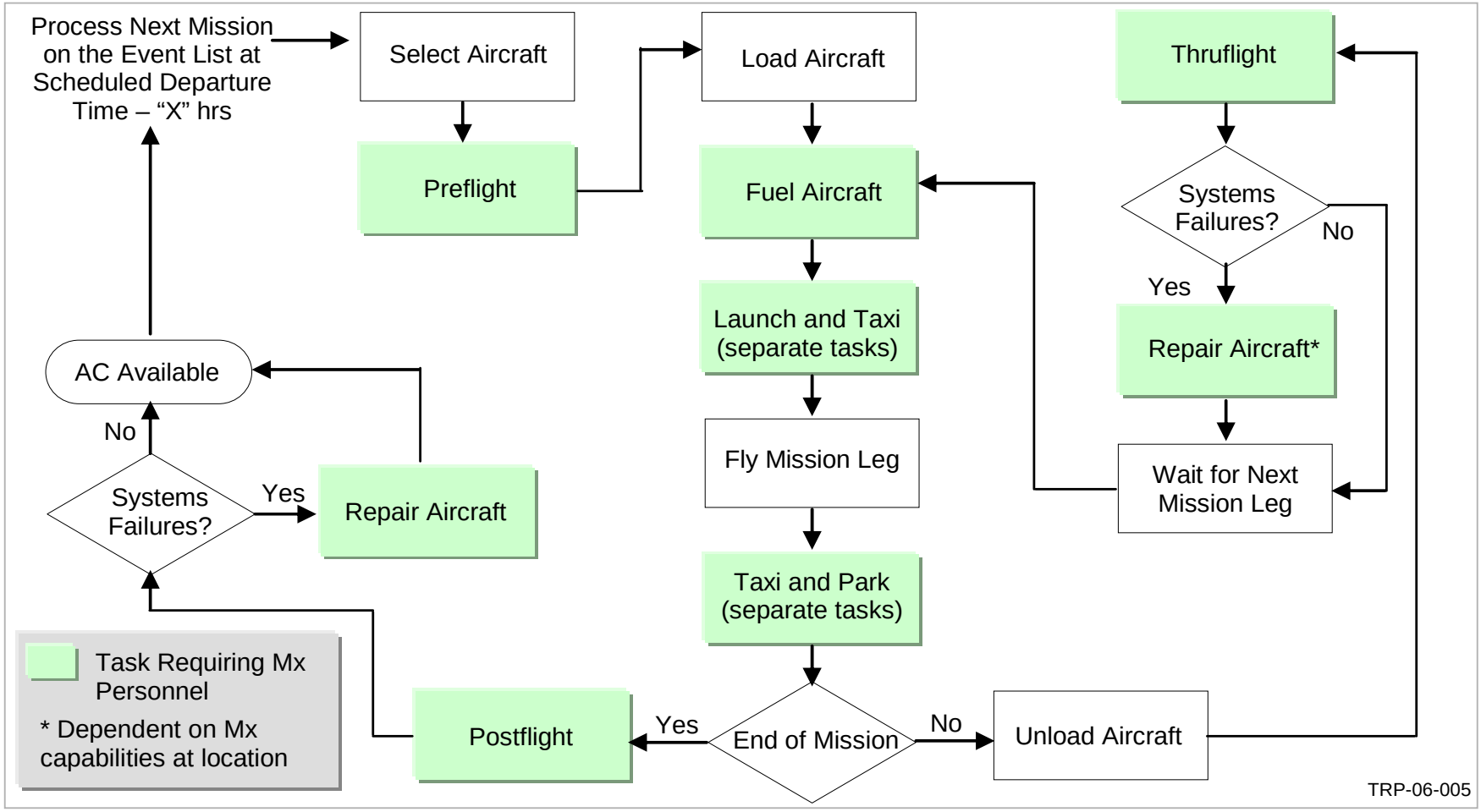
MAAF Inputs - Aircraft



MAAF Inputs – Missions & Mission Based Tasks

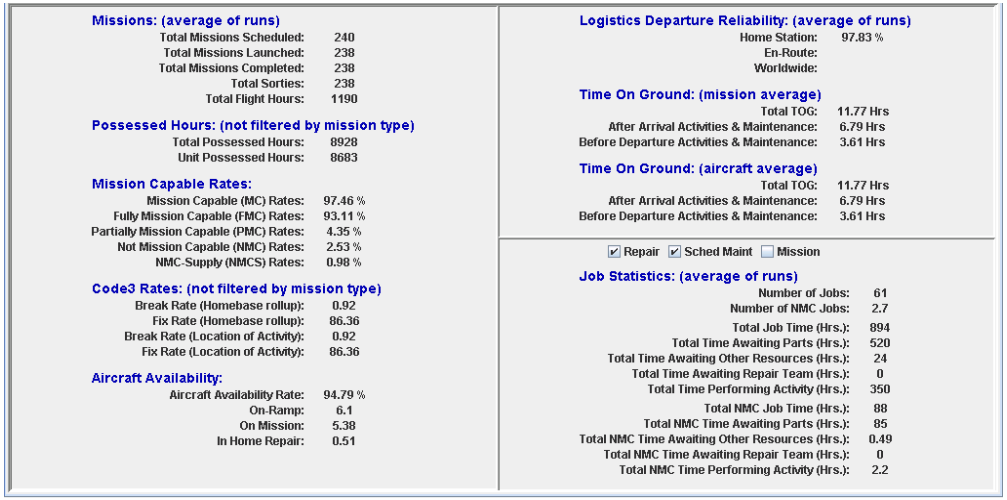


Mission Event Processing Cycle



MAAF Outputs

- Reports
  - **Summary Statistics**
    - Experiment Run Parameters
    - Mission / Sortie Accomplishment
    - MC Rates / Availability *(Including Material Availability)*
    - Departure Reliability
    - Time on Ground
  - **Graphical Reports**
    - MC Rates / Availability
    - Resource Utilization
    - Mission / Sortie Accomplishment
    - Departure Reliability
    - Resource Exceptions
  - **Logs**
    - Detailed simulation processing results by aircraft or mission



Missions: (average of runs)

Total Missions Scheduled:	240
Total Missions Launched:	238
Total Missions Completed:	238
Total Sorties:	238
Total Flight Hours:	1190

Possessed Hours: (not filtered by mission type)

Total Possessed Hours:	8928
Unit Possessed Hours:	8683

Mission Capable Rates:

Mission Capable (MC) Rates:	97.46 %
Fully Mission Capable (FMC) Rates:	93.11 %
Partially Mission Capable (PMC) Rates:	4.35 %
Not Mission Capable (NMC) Rates:	2.53 %
NMC-Supply (NMCS) Rates:	0.98 %

Code3 Rates: (not filtered by mission type)

Break Rate (Homebase rollup):	0.92
Fix Rate (Homebase rollup):	86.36
Break Rate (Location of Activity):	0.92
Fix Rate (Location of Activity):	86.36

Aircraft Availability:

Aircraft Availability Rate:	94.79 %
On-Ramp:	6.1
On Mission:	5.38
In Home Repair:	0.51

Logistics Departure Reliability: (average of runs)

Home Station:	97.83 %
En-Route:	
Worldwide:	

Time On Ground: (mission average)

Total TOG:	11.77 Hrs
After Arrival Activities & Maintenance:	6.79 Hrs
Before Departure Activities & Maintenance:	3.61 Hrs

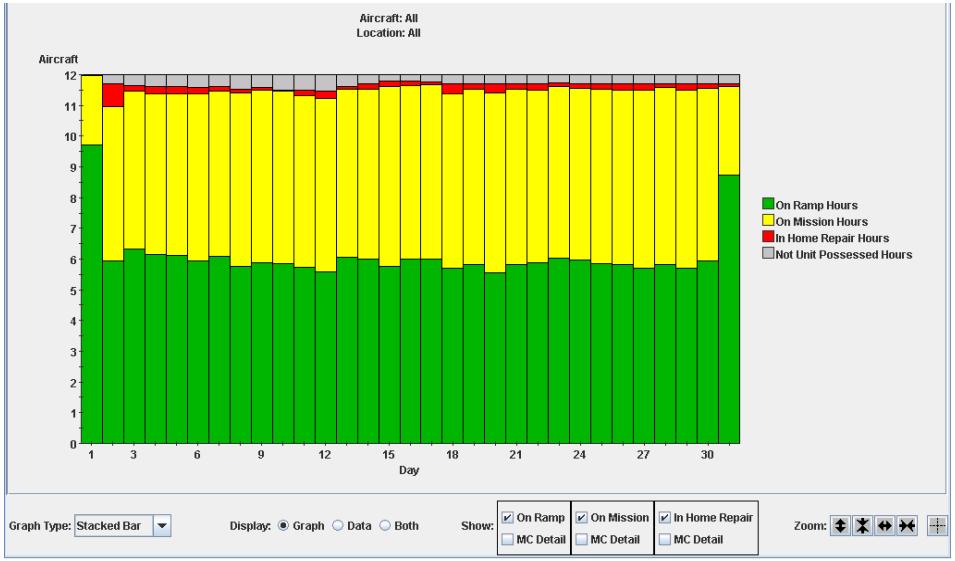
Time On Ground: (aircraft average)

Total TOG:	11.77 Hrs
After Arrival Activities & Maintenance:	6.79 Hrs
Before Departure Activities & Maintenance:	3.61 Hrs

☑ Repair ☑ Sched Maint ☐ Mission

Job Statistics: (average of runs)

Number of Jobs:	61
Number of NMC Jobs:	2.7
Total Job Time (Hrs.):	894
Total Time Awaiting Parts (Hrs.):	520
Total Time Awaiting Other Resources (Hrs.):	24
Total Time Awaiting Repair Team (Hrs.):	0
Total Time Performing Activity (Hrs.):	350
Total NMC Job Time (Hrs.):	88
Total NMC Time Awaiting Parts (Hrs.):	85
Total NMC Time Awaiting Other Resources (Hrs.):	0.49
Total NMC Time Awaiting Repair Team (Hrs.):	0
Total NMC Time Performing Activity (Hrs.):	2.2



Scenario and Trade Space

Scenario

NORTHROP GRUMMAN

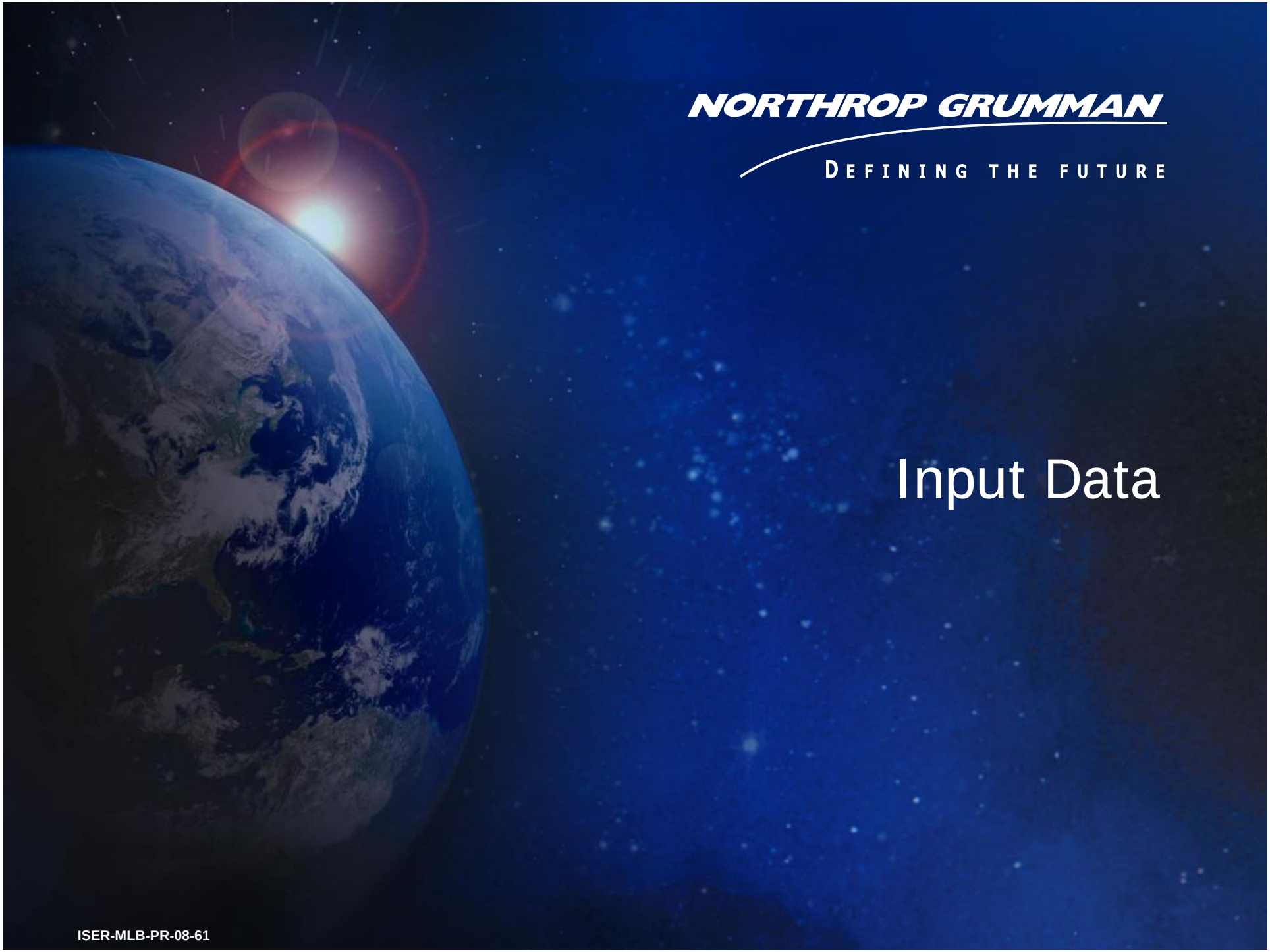
- 30 Day Operational Deployment
- 24/7 On-station / Orbit Coverage Requirement
- No/Limited Re-supply During The 30 Days
- Minimal Base Operating Support, Infrastructure
- Measures of Merit
  - Number of Aircraft
  - Number Of Personnel (Aircrew And Support)
  - Deployment Footprint
  - Schedule Effectiveness (Percent Of Scheduled Missions Actually Launched)
  - Cost

Note: Notional Aircraft Reliability, Maintainability, Supportability and Cost Data Used To Illustrate Our Methodology

Trade Space

NORTHROP GRUMMAN

- Number Of Aircraft, Aircrews
- Mission Duration
- Spares
- Support Equipment
- Maintenance/Support Personnel



Input Data

Baseline Input Data

NORTHROP GRUMMAN

- Orbit Location 1 Hour From Airbase
  - Ingress 1 Hour
  - On Station 3 Hours
  - Egress 1 Hours
  - Mission Duration 5 Hours
- Daily Sortie Schedule

5 Hour Mission

Cycle Repeats
Every 24 Hours

Mission	Launch Time	On Station	Off Station	Land
1	0000	0100	0400	0500
2	0300	0400	0700	0800
3	0600	0700	1000	1100
4	0900	1000	1300	1400
5	1200	1300	1600	1700
6	1500	1600	1900	2000
7	1800	1900	2200	2300
8	2100	2200	0100	0200

Baseline Input Data (Continued)

NORTHROP GRUMMAN

- Support Constraints

Preflight Tasks

Fuel	90 Minutes
Preflight	60 Minutes
Taxi / Launch	30 Minutes
Total Preflight	2.0 Hours

Post Flight Tasks

Taxi / Park	30 Minutes
Post Flight Insp.	60 Minutes
Total Postflight	1.5 Hours

Baseline Input Data (Continued)

NORTHROP GRUMMAN

- Operational Constraints

Max Crew Flight Hours

Flight Hours Logged	Per Consecutive Days
56	7
125	30
330	90

Other Aircrew Considerations

Max Crew Duty Day: 16 hours
Min Crew Rest Before Flight: 12 Hours
Crew Clock Reset after 7 Days Of Rest

Baseline Input Data (Continued)

- Support Equipment Needs

Support Equipment Type
Adapter, Pod
APU Hoist
APU Lifting Beam
APU Support Frame
Cooling Cart / Ducts
Cradle, Pod
Crane
Dolly, Engine Core
Dolly, Engine Thrust Reverser
Dolly, Fan Cowl
Engine Cradle
Engine Inlet Dolly/sling
ERAS Tool
HydraulicMule
Ladder
Nozzle Spanner
PowerCart
Sling
Sling, Engine Core
Sling, Fan Cowl
Sling, Pod
Spring Jack
Stand
Surge Damper Guide
Toolkit
Transport Dolly
Transport/Lift Trolley
Wheel Transport Dolly
Wheel Jacks
Power Cart
Air Conditioning Cart
Mission Planing Equipment
Life Support Equipment
NF-2 Light Cart

Baseline Input Data (Continued)

NORTHROP GRUMMAN

- Maintenance/Support Personnel

Skill
Comm-Nav
Aerospace Maint.
Propulsion
Fuels
Pneudraulics
Elec- Env.

Baseline Input Data (Continued)

NORTHROP GRUMMAN

- Reliability/Mission Essential Equipment Data

Aircraft Systems: Add System

Qty	WUC	Item/SubSystem	FSL	A	B	C	D	MTBF	Repair Actions
2	212117	FAN-RECIRCULATION	✔	1	0	0	0	59408.0	Edit Repair Actions[1]...
3	212131	ACTUATOR-ROTARY		0	0	0	0	104343.0	Edit Repair Actions[1]...
2	212204	ARO/MCO Console Fan	✔	1	0	0	0	50000.0	Edit Repair Actions[1]...
1	212607	Avionics Bay Blowing Fan		0	0	0	0	287801.0	Edit Repair Actions[1]...
2	212801	Check Valve	✔	1	0	0	0	50000.0	Edit Repair Actions[1]...
2	213222	CONTROLLER-PRESSURE		0	0	0	0	25878.0	Edit Repair Actions[1]...
4	213233	BOX-ELECTRONIC	✔	1	0	0	0	51756.0	Edit Repair Actions[1]...
2	213234	VALVE-OUTFLOW	✔	1	0	0	0	38176.0	Edit Repair Actions[1]...
3	213240	VALVE-SAFETY	✔	1	0	0	0	20600.0	Edit Repair Actions[1]...
2	215151	VALVE-FLOW CONTROL	✔	1	0	0	0	46420.0	Edit Repair Actions[1]...
2	215224	CHAMBER-AIR PLENUM	✔	1	0	0	0	118980.0	Edit Repair Actions[1]...
2	215262	MACHINE-AIR CYCLE	✔	1	0	0	0	80804.0	Edit Repair Actions[1]...
2	215315	VALVE-BYPASS	✔	1	0	0	0	41200.0	Edit Repair Actions[1]...
2	215315a	VALVE-ANTI-ICING	✔	1	0	0	0	64166.0	Edit Repair Actions[1]...
2	215334	CONTROLLER-PACK TEMPERATURE	✔	1	0	0	0	150366.0	Edit Repair Actions[1]...
2	215351	ACTUATOR-RAM AIR INLET	✔	1	0	0	0	38176.0	Edit Repair Actions[1]...
1	215552	ACTUATOR-EMERGENCY,RAM AIR	✔	1	0	0	0	12939.0	Edit Repair Actions[1]...
1	216208	Avionics Bay Extraction Fan		0	0	0	0	15000.0	Edit Repair Actions[1]...
8	216351	VALVE-TRIM AIR	✔	1	0	0	0	30540.0	Edit Repair Actions[1]...
2	216352	VALVE-TRIM AIR PRESSURE		0	0	0	0	41200.0	Edit Repair Actions[1]...
2	228112	FCU-FLIGHT CONTROL UNIT	✔	1	0	0	0	20600.0	Edit Repair Actions[1]...
3	228201	MCDU	✔	1	0	0	0	15251.0	Edit Repair Actions[1]...
3	228212	MCDU-MULTIPURPOSE CONTROL AND ...	✔	2	0	0	0	138984.0	Edit Repair Actions[1]...
2	228355	FMGEC-FLIGHT MANAGEMENT GUIDANC...	✔	1	0	0	0	59582.0	Edit Repair Actions[1]...
2	231070	TRANSCEIVER-HF	✔	1	0	0	0	92656.0	Edit Repair Actions[1]...
3	231290	TRANSCEIVER-VHF		0	0	0	0	121206.0	Edit Repair Actions[1]...

Adjust Selected MTBF (factor): Apply

Initial Results

Baseline Results – MAAF Output

NORTHROP GRUMMAN

Project: MORS Paper **Experiment: baseline**

Aircraft: All
Location: Osan AB
Mission Type: All

Warmup Days: 0
No. of Runs: 100
Days in Exp: 31
Code3 fix time (hrs): 12.0
All Repair Times are NMC

Optional Settings

Missions: (average of runs)

Total Missions Scheduled:	240
Total Missions Launched:	239
Total Missions Completed:	237
Total Sorties:	239
Total Flight Hours:	1191

Possessed Hours: (not filtered by mission type)

Total Possessed Hours:	4464
Unit Possessed Hours:	4464

Mission Capable Rates:

Mission Capable (MC) Rates:	94.9 %
Fully Mission Capable (FMC) Rates:	84.06 %
Partially Mission Capable (PMC) Rates:	10.84 %
Not Mission Capable (NMC) Rates:	5.09 %
NMC-Supply (NMCS) Rates:	3.7 %

Code3 Rates: (not filtered by mission type)

Break Rate (Homebase rollup):	1.08
Fix Rate (Homebase rollup):	81.08
Break Rate (Location of Activity):	1.08
Fix Rate (Location of Activity):	81.08

Aircraft Availability:

Aircraft Availability Rate:	94.9 %
On-Ramp:	1.87
On Mission:	4.04
In Home Repair:	0.07

Logistics Departure Reliability: (average of runs)

Home Station:	99.58 %
En-Route:	
Worldwide:	

Time On Ground: (mission average)

Total TOG:	7.59 Hrs
After Arrival Activities & Maintenance:	2.64 Hrs
Before Departure Activities & Maintenance:	3.53 Hrs

Time On Ground: (aircraft average)

Total TOG:	7.59 Hrs
After Arrival Activities & Maintenance:	2.64 Hrs
Before Departure Activities & Maintenance:	3.53 Hrs

☑ Repair ☑ Sched Maint ☐ Mission

Job Statistics: (average of runs)

Number of Jobs:	47
Number of NMC Jobs:	2.9
Total Job Time (Hrs.):	1,030
Total Time Awaiting Parts (Hrs.):	960
Total Time Awaiting Other Resources (Hrs.):	11
Total Time Awaiting Repair Team (Hrs.):	0
Total Time Performing Activity (Hrs.):	59
Total NMC Job Time (Hrs.):	169
Total NMC Time Awaiting Parts (Hrs.):	166
Total NMC Time Awaiting Other Resources (Hrs.):	0.31
Total NMC Time Awaiting Repair Team (Hrs.):	0
Total NMC Time Performing Activity (Hrs.):	2.8

Baseline Results

NORTHROP GRUMMAN

- Maintenance/Support Personnel

Skill	1st Shift	2nd Shift	3rd Shift	Total
Comm-Nav	3	4	3	**10**
Aerospace Maint.	11	9	9	**29**
Propulsion	3	3	2	**8**
Fuels	3	2	2	**7**
Pneudraulics	2	2	2	**6**
Elec- Env.	2	2	2	**6**
Totals	**24**	**22**	**20**	**66**

Baseline Results

NORTHROP GRUMMAN

- Number Of Aircraft Required

5 Hour mission										
Number of aircraft	1	2	3	4	5	6	7	8	9	10
Sorties Launched	55	114	164	210	236	239	239	240	240	240
Sch Effectiveness	22.92%	47.50%	68.33%	87.50%	98.33%	99.58%	99.58%	100.00%	100.00%	100.00%
Total Flight Hours	276	568	817	1,049	1,176	1,193	1,193	1,195	1,195	1,195
MC	92.39%	95.33%	92.41%	90.96%	94.09%	95.47%	95.78%	95.70%	97.39%	96.58%
NMC	7.60%	4.66%	7.58%	9.03%	5.90%	4.52%	4.21%	4.29%	2.60%	3.41%
NMCS	3.83%	1.91%	4.49%	5.92%	4.08%	2.88%	2.87%	3.29%	1.75%	2.36%
Break rate	1.08%	1.00%	1.22%	1.34%	1.12%	1.18%	1.09%	1.23%	1.09%	1.17%
Fix rate	80.00%	91.22%	83.00%	76.59%	84.84%	80.85%	81.67%	92.31%	83.96%	77.30%
Departure Rel	21.96%	45.00%	64.87%	84.00%	97.53%	99.69%	99.83%	100.00%	100.00%	100.00%
On-ramp	0.09	0.14	0.31	0.54	0.96	1.87	2.86	3.85	4.85	5.85
On-mission	0.88	1.82	2.62	3.38	3.96	4.05	4.06	4.06	4.06	4.06
In home repair	0.01	0.03	0.05	0.06	0.07	0.07	0.07	0.07	0.07	0.07
On-ramp (%)	9.0%	7.0%	10.3%	13.5%	19.2%	31.2%	40.9%	48.1%	53.9%	58.5%
On-mission (%)	88.0%	91.0%	87.3%	84.5%	79.2%	67.5%	58.0%	50.8%	45.1%	40.6%
In home repair (%)	1.0%	1.5%	1.7%	1.5%	1.4%	1.2%	1.0%	0.9%	0.8%	0.7%

240 Missions Scheduled

Baseline Results

NORTHROP GRUMMAN

- Support Equipment

Support Equipment	Quantity
Adapter, Pod	1
APU Hoist	1
APU Lifting Beam	1
APU Support Frame	1
Cooling Cart / Ducts	1
Cradle, Pod	1
Crane	1
Dolly, Engine Core	1
Dolly, Engine Thrust Reverser	1
Dolly, Fan Cowl	1
Engine Cradle	1
Engine Inlet Dolly/sling	1
ERAS Tool	
Hydraulic Mule	1
Ladder	1
Nozzle Spanner	1
Power Cart	1
Sling	1
Sling, Engine Core	1
Sling, Fan Cowl	1
Sling, Pod	1
Spring Jack	0
Stand	3
Surge Damper Guide	1
Toolkit	3
Transport Dolly	1
Transport/Lift Trolley	2
Wheel Transport Dolly	2
WheelJacks	2
Totals	**34.00**

Baseline Results

NORTHROP GRUMMAN

- Spares

QPA	WUC	Item Nomenclature	Quantity
2	212117	FAN-RECIRCULATION	
3	212131	ACTUATOR-ROTARY	
2	212204	ARO/MCO Console Fan	1
1	212607	Avionics Bay Blowing Fan	
2	212801	Check Valve	1
2	213222	CONTROLLER-PRESSURE	1
4	213233	BOX-ELECTRONIC	1
2	213234	VALVE-OUTFLOW	1
3	213240	VALVE-SAFETY	1
2	215151	VALVE-FLOW CONTROL	1
2	215224	CHAMBER-AIR PLENUM	1
2	215262	MACHINE-AIR CYCLE	
2	215315	VALVE-BYPASS	1
2	215315a	VALVE-ANTI-ICING	
2	215334	CONTROLLER-PACK TEMPERATURE	
2	215351	ACTUATOR-RAM AIR INLET	1
1	215552	ACTUATOR-EMERGENCY,RAM AIR	3
1	216208	Avionics Bay Extraction Fan	1
8	216351	VALVE-TRIM AIR	1
2	216352	VALVE-TRIM AIR PRESSURE	1
2	228112	FCU-FLIGHT CONTROL UNIT	1
3	228201	MCDU	2
8	MLG	WHEEL-LDG	10
2	NG	WHEEL-NLG	5
		Total	**265**

Excursions

NORTHROP GRUMMAN

- Excursion 1: Impact Of Increasing Mission Duration From 5 to 8 Hours
  - Increasing Time On Station Per Sortie From 3 to 6 Hours
- Excursion 2: Impact Of No Spare Engine

Excursion 1: 8 Hour Mission Duration - Input Data

- Time On Orbit Per Mission Doubled

8 Hour Mission

Cycle Repeats
Every 24 Hours

Mission	Launch Time	On Station	Off Station	Land
1	0000	0100	0700	0800
2	0600	0700	1300	1400
3	1200	1300	1900	2000
4	1800	1900	0100	0200

1 Hour Ingress
6 Hours on Station
1 Hour Egress

All Other Input Data Unchanged

Excursion 1: 8 Hour Mission – MAAF Results

NORTHROP GRUMMAN

Project: MORS Paper **Experiment: baseline**

Aircraft: All
Location: Yokota AB
Mission Type: All

Warmup Days: 0
No. of Runs: 100
Days in Exp: 31
Code3 fix time (hrs): 12.0
All Repair Times are NMC

Optional Settings

Missions: (average of runs)

Total Missions Scheduled:	120
Total Missions Launched:	119
Total Missions Completed:	118
Total Sorties:	119
Total Flight Hours:	949

Possessed Hours: (not filtered by mission type)

Total Possessed Hours:	3720
Unit Possessed Hours:	3720

Mission Capable Rates:

Mission Capable (MC) Rates:	94.15 %
Fully Mission Capable (FMC) Rates:	80.98 %
Partially Mission Capable (PMC) Rates:	13.17 %
Not Mission Capable (NMC) Rates:	5.84 %
NMC-Supply (NMCS) Rates:	4.7 %

Code3 Rates: (not filtered by mission type)

Break Rate (Homebase rollup):	1.82
Fix Rate (Homebase rollup):	75.92
Break Rate (Location of Activity):	1.82
Fix Rate (Location of Activity):	75.92

Aircraft Availability:

Aircraft Availability Rate:	94.15 %
On-Ramp:	2.38
On Mission:	2.55
In Home Repair:	0.05

Logistics Departure Reliability: (average of runs)

Home Station:	99.7 %
En-Route:	
Worldwide:	

Time On Ground: (mission average)

Total TOG:	7.89 Hrs
After Arrival Activities & Maintenance:	2.64 Hrs
Before Departure Activities & Maintenance:	3.75 Hrs

Time On Ground: (aircraft average)

Total TOG:	7.89 Hrs
After Arrival Activities & Maintenance:	2.64 Hrs
Before Departure Activities & Maintenance:	3.75 Hrs

☑ Repair ☑ Sched Maint ☐ Mission

Job Statistics: (average of runs)

Number of Jobs:	35
Number of NMC Jobs:	2.2
Total Job Time (Hrs.):	953
Total Time Awaiting Parts (Hrs.):	897
Total Time Awaiting Other Resources (Hrs.):	10
Total Time Awaiting Repair Team (Hrs.):	0
Total Time Performing Activity (Hrs.):	45
Total NMC Job Time (Hrs.):	177
Total NMC Time Awaiting Parts (Hrs.):	175
Total NMC Time Awaiting Other Resources (Hrs.):	0.4
Total NMC Time Awaiting Repair Team (Hrs.):	0
Total NMC Time Performing Activity (Hrs.):	1.7

Excursion 1: 8 Hour Mission - Results

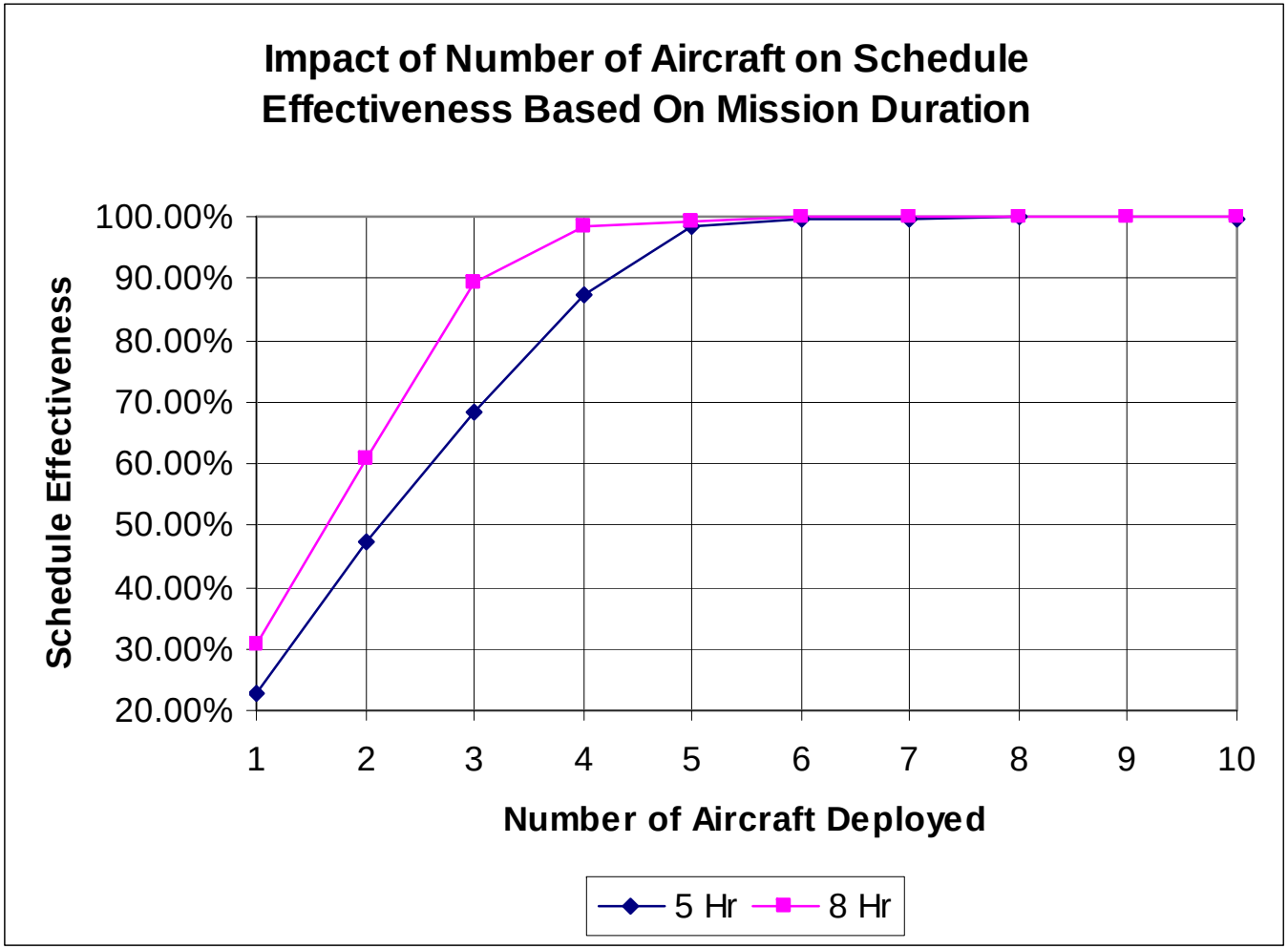
NORTHROP GRUMMAN

- Number Of Aircraft Required

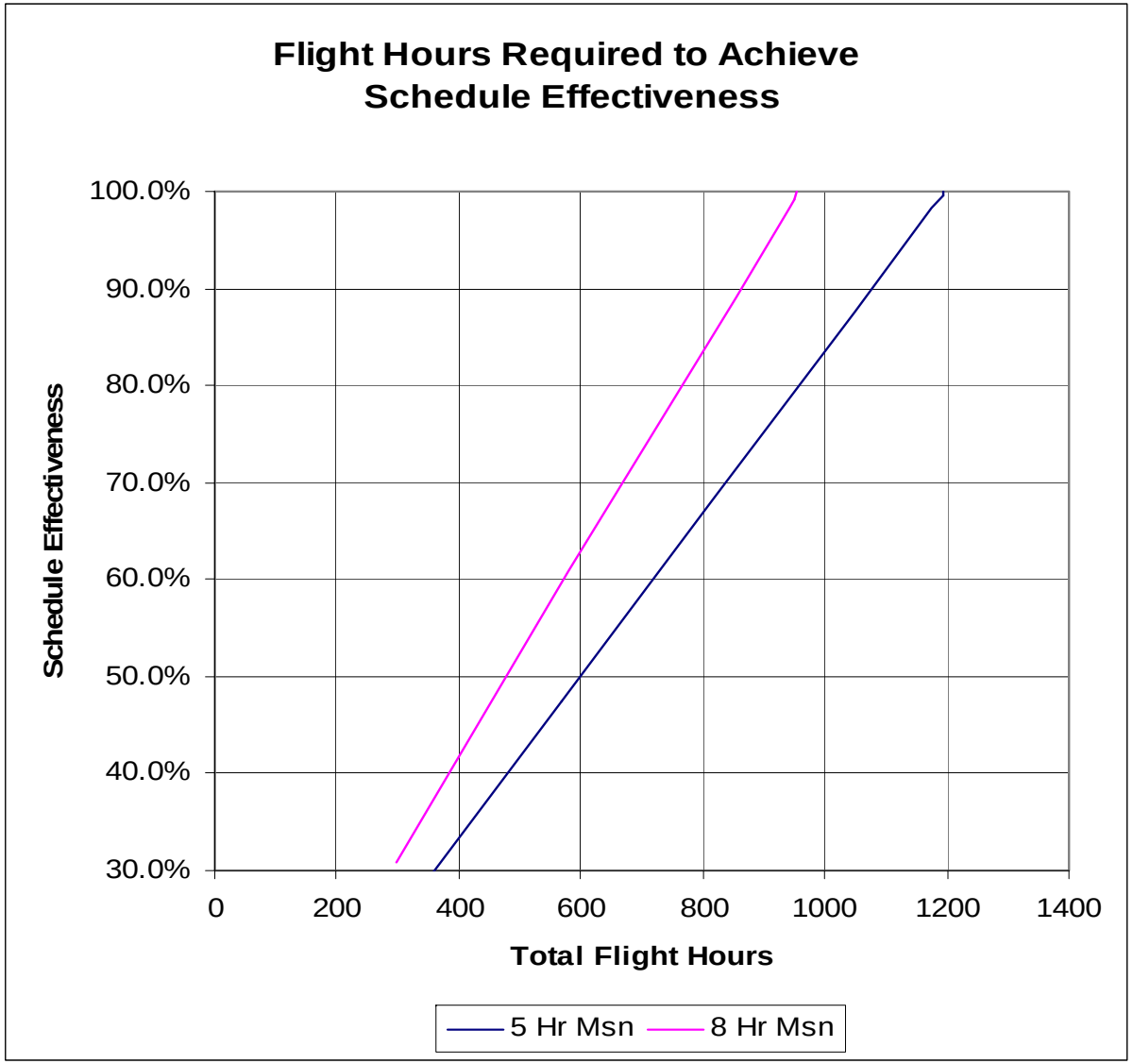
8 Hour mission										
Number of aircraft	1	2	3	4	5	6	7	8	9	10
Sorties Launched	37	73	107	118	119	120	120	120	120	120
Sch Effectiveness	30.83%	60.83%	89.17%	98.33%	99.17%	100.00%	100.00%	100.00%	100.00%	100.00%
Total Flight Hours	298	580	856	941	951	952	952	952	952	952
MC	91.82%	89.76%	89.46%	92.00%	93.76%	95.64%	96.12%	95.60%	97.43%	97.28%
NMC	8.17%	10.23%	10.56%	7.99%	6.23%	4.35%	3.87%	4.39%	2.56%	2.71%
NMCS	6.31%	7.84%	8.85%	5.97%	4.40%	2.86%	2.69%	3.42%	1.94%	2.06%
Break rate	1.71%	2.04%	1.62%	1.76%	1.68%	1.73%	1.56%	1.71%	1.61%	1.86%
Fix rate	81.25%	75.67%	70.11%	69.60%	78.01%	72.81%	72.04%	65.68%	80.20%	72.92%
Departure Rel	31.15%	60.73%	89.81%	98.90%	99.89%	100.00%	100.00%	100.00%	100.00%	100.00%
On-ramp	0.18	0.40	0.64	1.40	2.38	3.36	4.38	5.38	6.38	7.38
On-mission	0.79	1.55	2.29	2.53	2.56	2.56	2.56	2.58	2.58	2.58
In home repair	0.01	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
On-ramp (%)	18.0%	20.0%	21.3%	35.0%	47.6%	56.0%	62.6%	67.3%	70.9%	73.8%
On-mission (%)	79.0%	77.5%	76.3%	63.3%	51.2%	42.7%	36.6%	32.3%	28.7%	25.8%
In home repair (%)	1.0%	1.5%	1.7%	1.3%	1.0%	0.8%	0.7%	0.6%	0.6%	0.5%

120 Missions Scheduled

Number of Aircraft Comparison



Total Flight Hours Comparison



Excursion 1: 8 Hour Mission Results

NORTHROP GRUMMAN

- Maintenance/Support Personnel

Skill	1st Shift	2nd Shift	3rd Shift	Total
Comm-Nav	2	3	2	**7**
Aerospace Maint.	7	7	7	**21**
Propulsion	0	3	2	**5**
Fuels	2	2	2	**6**
Pneudraulics	1	2	2	**5**
Elec- Env.	2	3	3	**8**
Totals	**14**	**20**	**18**	**52**

Excursion 1: 8 Hour Mission Results

NORTHROP GRUMMAN

- Support Equipment

Support Equipment	Quantity
Adapter, Pod	1
APU Hoist	1
APU Lifting Beam	1
APU Support Frame	1
Cooling Cart / Ducts	1
Cradle, Pod	1
Crane	1
Dolly, Engine Core	1
Dolly, Engine Thrust Reverser	1
Dolly, Fan Cowl	1
Engine Cradle	1
Engine Inlet Dolly/sling	1
ERAS Tool	0
Hydraulic Mule	1
Ladder	1
Nozzle Spanner	1
Power Cart	1
Sling	1
Sling, Engine Core	1
Sling, Fan Cowl	1
Sling, Pod	1
Spring Jack	
Stand	3
Surge Damper Guide	1
Toolkit	4
Transport Dolly	1
Transport/Lift Trolley	2
Wheel Transport Dolly	2
WheelJacks	2
Totals	**35.00**

Excursion 1: 8 Hour Mission Results

NORTHROP GRUMMAN

- Spares

QPA	WUC	Item Nomenclature	Quantity
2	212117	FAN-RECIRCULATION	1
3	212131	ACTUATOR-ROTARY	1
2	212204	ARO/MCO Console Fan	
1	212607	Avionics Bay Blowing Fan	
2	212801	Check Valve	1
2	213222	CONTROLLER-PRESSURE	1
4	213233	BOX-ELECTRONIC	1
2	213234	VALVE-OUTFLOW	1
3	213240	VALVE-SAFETY	1
2	215151	VALVE-FLOW CONTROL	1
2	215224	CHAMBER-AIR PLENUM	1
2	215262	MACHINE-AIR CYCLE	1
2	215315	VALVE-BYPASS	1
2	215315a	VALVE-ANTI-ICING	
2	215334	CONTROLLER-PACK TEMPERATURE	
2	215351	ACTUATOR-RAM AIR INLET	1
1	215552	ACTUATOR-EMERGENCY,RAM AIR	1
1	216208	Avionics Bay Extraction Fan	1
8	216351	VALVE-TRIM AIR	1
2	216352	VALVE-TRIM AIR PRESSURE	1
2	228112	FCU-FLIGHT CONTROL UNIT	1
3	228201	MCDU	2
8	MLG	WHEEL-LDG	8
2	NG	WHEEL-NLG	4
		Total	**233**

Excursion 1: 8 Hour Mission Observations

NORTHROP GRUMMAN

- Shifting From A 5 Hour Mission To An 8 Hour Mission:
  - Cuts The Number Of Missions Required In Half
  - Reduces The Number Of Aircraft Required
  - Support Tail Impacts
    - Number Of Personnel Reduced
    - Number Of Spares Reduced
    - Number Of Pieces Of SE Increased By 1

Excursion 2: No Spare Engine - Input Data

NORTHROP GRUMMAN

- Same 5-Hour and 8-Hour Mission Profiles
- No Propulsion Personnel Deployed
- No Engine-specific Spares, Support Equipment Deployed

Excursion 2: No Spare Engine – Results

NORTHROP GRUMMAN

5 Hour Mission

Missions: (average of runs)

Total Missions Scheduled:	240
Total Missions Launched:	239
Total Missions Completed:	237
Total Sorties:	239
Total Flight Hours:	1192

Possessed Hours: (not filtered by mission type)

Total Possessed Hours:	4464
Unit Possessed Hours:	4464

Mission Capable Rates:

Mission Capable (MC) Rates:	93.69 %
Fully Mission Capable (FMC) Rates:	84.26 %
Partially Mission Capable (PMC) Rates:	9.43 %
Not Mission Capable (NMC) Rates:	6.3 %
NMC-Supply (NMCS) Rates:	3.74 %

Code3 Rates: (not filtered by mission type)

Break Rate (Homebase rollup):	1.15
Fix Rate (Homebase rollup):	78.62
Break Rate (Location of Activity):	1.15
Fix Rate (Location of Activity):	78.62

Aircraft Availability:

Aircraft Availability Rate:	93.69 %
On-Ramp:	1.87
On Mission:	4.05
In Home Repair:	0.07

8 Hour Mission

Missions: (average of runs)

Total Missions Scheduled:	120
Total Missions Launched:	117
Total Missions Completed:	116
Total Sorties:	117
Total Flight Hours:	929

Possessed Hours: (not filtered by mission type)

Total Possessed Hours:	2976
Unit Possessed Hours:	2976

Mission Capable Rates:

Mission Capable (MC) Rates:	91.48 %
Fully Mission Capable (FMC) Rates:	76.74 %
Partially Mission Capable (PMC) Rates:	14.73 %
Not Mission Capable (NMC) Rates:	8.51 %
NMC-Supply (NMCS) Rates:	5.72 %

Code3 Rates: (not filtered by mission type)

Break Rate (Homebase rollup):	1.71
Fix Rate (Homebase rollup):	70.85
Break Rate (Location of Activity):	1.71
Fix Rate (Location of Activity):	70.85

Aircraft Availability:

Aircraft Availability Rate:	91.48 %
On-Ramp:	1.44
On Mission:	2.49
In Home Repair:	0.05

Excursion 2: No Spare Engine - Results

NORTHROP GRUMMAN

	5 Hour Mission	8 Hour Mission
Number of Aircraft	6	4
Number of Aircrew	10	8
Number of Maintenance Personnel	58	47
Number of Spares	257	227
Number of SE	24	25
Number of Missions	240	120
Number of Flight Hours	1200	960

Reductions In Maintenance Personnel, Number of Spares and Support Equipment

Deployment Footprint

Logistics (Mobility) Footprint

NORTHROP GRUMMAN

Mobility Footprint (Pallet Equivalent)	Spare Engine	
	5 Hour Mission	8 Hour Mission
Aircrew	0.0	0.0
Maintenance Personnel	5.0	4.0
Spares	4.5	4.0
Support Equipment	16.9	17.1
Additional Support Requirements	14.8	14.8
Total Pallets	41.2	39.9

Mobility Footprint (Pallet Equivalent)	No Spare Engines	
	5 Hour Mission	8 Hour Mission
Aircrew	0.0	0.0
Maintenance Personnel	4.0	4.0
Spares	3.1	2.6
Support Equipment	15.0	15.2
Additional Support Requirements	14.8	14.8
Total Pallets	37.0	36.6

Aircrew Personnel Carried In Deploying Aircraft

Palletized Footprint Comparisons

NORTHROP GRUMMAN

Mobility Aircraft Equivalents	Spare Engine	
	5 Hour Mission	8 Hour Mission
C-17 (18 Pallets)	2.3	2.2
KC-45 (32 Pallet Positions)	1.3	1.2
KC-10 (27 Pallet Positions)	1.5	1.5
KC-135 (6 Pallet Positions)	6.9	6.6

Mobility Aircraft Equivalents	No Spare Engine	
	5 Hour Mission	8 Hour Mission
C-17 Equivalents (18 Pallets)	2.1	2.0
KC-45 (32 Pallet Positions)	1.2	1.1
KC-10 (27 Pallet Positions)	1.4	1.4
KC-135 (6 Pallet Positions)	6.2	6.1

Cost Implications

Relative Cost Comparisons

NORTHROP GRUMMAN

	Spare Engine	
	5 Hour Mission	8 Hour Mission
Number of Aircraft	6	4
Number of Aircrew	10	8
Number of Maintenance Personnel	66	52
Number of Spares	265	233
Number of SE	34	35
Number of Missions	240	120
Number of Flight Hours	1200	960

	Spare Engine	
Deployment Cost	5 Hour Mission	8 Hour Mission
Aircraft (pro rated Life)	$ 4,469,274	$ 2,979,516
Aircrew	$ 294,200	$ 235,360
Maintenance Personnel	$ 421,850	$ 332,367
Spares	$ 327,988	$ 303,987
Support Equipment	$ 4,141	$ 4,155
Fuel @2000 gal/hr	$ 5,400,000	$ 4,320,000
Total	$ 10,917,453	$ 8,175,385

Assumptions:

Average Annual DOD Composite Personnel Rate
Pro Rated Aircraft Cost Assumes 25 Year Service Life
Spares Cost Assumes 10 Year Life
Support Equipment Assumes 15 Year Life
Fuel Cost From DESC Fuel Cost Projections

Cost Comparisons

NORTHROP GRUMMAN

	No Spare Engines	
	5 Hour Mission	8 Hour Mission
Number of Aircraft	6	4
Number of Aircrew	10	8
Number of Maintenance Personnel	58	47
Number of Spares	257	227
Number of SE	24	25
Number of Missions	240	120
Number of Flight Hours	1200	960

	No Spare Engines	
Deployment Cost	5 Hour Mission	8 Hour Mission
Aircraft (pro rated Life)	$ 4,469,274	$ 2,979,516
Aircrew	$ 294,200	$ 235,360
Maintenance Personnel	$ 370,717	$ 300,408
Spares	$ 179,499	$ 156,916
Support Equipment	$ 3,173	$ 3,187
Fuel @2000 gal/hr	$ 5,400,000	$ 4,320,000
Total	$ 10,716,863	$ 7,995,387

Assumptions: Same As Previous

Two Simple Changes Resulted In A 27% Cost Reduction For The Deployment

Conclusions

Conclusions

NORTHROP GRUMMAN

- Using A Tool Like MAAF To Model A Deployment Provides A Closed-Loop, Simulation Based Assessment Of
  - Operational Impacts Driven By
    - Basic System R&M
    - Mission Duration /Scheduling
    - Surge Requirements
  - Deployment Footprint
    - Personnel (Aircrew & Mission Crew)
    - Spares And Consumables (Including Repair Pipeline)
    - Support Equipment
  - Changes To Operations And Support Resources Can Be Fed Back Into The Model To Assess The Impact
- Using This Methodology Allows Relative Comparison Of Costs Associated With Alternative Deployment Strategies


NORTHROP GRUMMAN
DEFINING THE FUTURE
Questions?


NORTHROP GRUMMAN
DEFINING THE FUTURE